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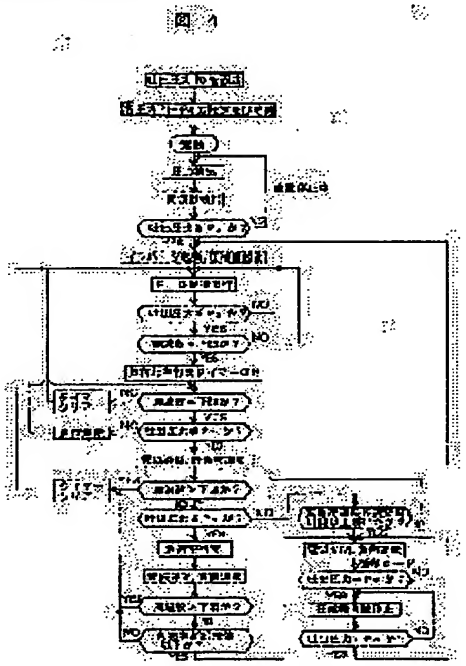
(54) METHOD FOR OPERATING SCREW COMPRESSOR AND THE SCREW COMPRESSOR

(57)Abstract:
PROBLEM TO BE SOLVED: To reduce the generation of a power in the low load region of a screw compressor and to prevent the generation of drain in an oil separator due to repetition of frequent starting and stop.
SOLUTION: In control of capacity of the screw compressor driven by an inverter, when a consumption air amount of the compressor is reduced to a value lower than a given amount or a load to a value lower than a given amount, the discharge pressure and the power of the compressor are relieved by switching control, theretofore carried out, of the number of revolutions to other capacity control system, such as closing of a throttle valve situated on the suction side of the compressor.



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CLAIMS

[Claim(s)]
[Claim 1] In the operating method of the screw compressor in which gear change operation driven with the motor using an inverter is possible While setting the rotational frequency of said compressor as the minimum rotational frequency which the rotational frequency of said compressor is changed and is used by revolving-speed-control operation corresponding to change of a load, and this revolving-speed-control operation From the predetermined load which was equipped with no-load running which closes the intake throttle valve prepared in the said screw compressor's intake side, and decompresses the discharge pressure of said screw compressor, and was defined beforehand, at the time of a low load The operating method of the screw compressor characterized by repeating load operation set as the minimum rotational frequency of said revolving-speed-control.operation, and said no-load running.
[Claim 2] The operating method of the screw compressor according to claim 1 characterized by suspending said screw compressor when said no-load running continues beyond predetermined time at least, and when it becomes one when the time amount ratio of no-load running in operation at the time of said low load and said load operation exceeds a predetermined rate of operations.
[Claim 3] It is the operating method of the screw compressor according to claim 1 characterized by setting the upper limit P1 of the discharge pressure of a compressor as P1>P0 to the setting pressure P0 of said revolving-speed-control operation when changing to the operation mode which repeats no-load running which blockades an absorption throttle valve and decompresses the discharge pressure of a compressor, and load operation after loads decrease in number and the rotational frequency of said compressor is set as the minimum rotational frequency of revolving-speed-control operation.
[Claim 4] In the screw compressor which prepared the absorption throttle valve which has Rota of the male-and-female pair supported by bearing pivotable, is equipped with the motor which drives this Rota, and the inverter which controls this motor, and adjusts a flow rate to a suction side A revolving-speed-control means to change the engine speed of said motor with an inverter, and to control the capacity of said screw compressor, The screw compressor characterized by having the capacity control means to which no-load running which blockades said sink throttle valve while driving said screw compressor with the minimum engine speed set as this revolving-speed-control means, and decompresses the discharge pressure of said screw compressor is made to carry out.
[Claim 5] It is the screw compressor according to claim 4 characterized by said capacity control means setting the lower limit of the discharge pressure when changing to load operation which is operation which opens P1 for the upper limit of the discharge pressure when changing said compressor to no-load running, and opens said compressor for the sink throttle valve in said minimum engine speed as P1 and P2 so that it may be set to P1>P0 and P2>=P0 when the setting pressure of P2 and revolving-speed-control operation is set to P0.
[Claim 6] While forming a discharge-pressure detection means to detect the discharge pressure of said compressor in the discharge side of a compressor The setting pressure (P0) in revolving speed control, and upper-limit-of-pressure force (P1) and lower-limit pressure force (P2) of a displacement control, A storage means to memorize the pressure (P3) made to stop automatically and the reboot pressure after automatic stay (P4), The change means which changes actuation of said revolving-speed-control means and said capacity control means based on the detection pressure force detected by said discharge-pressure detection means, The screw compressor according to claim 4 characterized by establishing the input means whose modification of the value of P0, P1, P2, P3, and P4 which were memorized by said storage means is enabled.
[Claim 7] The setting pressure (P0) in revolving speed control, and upper-limit-of-pressure force (P1) and lower-limit pressure force (P2) of a displacement control, The screw compressor according to claim 4 characterized by having a storage means to memorize the pressure (P3) made to stop automatically and the reboot pressure after automatic stay (P4), and the setting pressure means which carries out an operation

setup of each setting pressur[redacted], P2, P3, P4) based on said setting pressur[redacted]0).
[Claim 8] It is the operating method of the screw compressor according to claim 2 which continues operation of a predetermined time (t1) compressor even if loads decrease in number, and is characterized by after predetermined time (t1) progress stopping a compressor when the pressure of said compressor declines and a compressor reboots.
[Claim 9] The screw compressor according to claim 4 characterized by operating a capacity control means by the low load from the load defined beforehand based on the discharge pressure which this discharge-pressure detection means detected while a revolving-speed-control means carries out revolving speed control based on the discharge pressure which established a discharge-pressure detection means to detect a discharge pressure, and this discharge-pressure detection means detected.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention changes the rotational frequency of a driving motor using an inverter, and relates to the operating method of a screw compressor and screw compressor which adjust the capacity of a compressor.
[0002]
[Description of the Prior Art] In the conventional screw compressor, like the publication to JP,7-35079,A, a compressor is absorbed to that inhalation opening, and has the throttle valve, and it had opened and closed with the solenoid valve which opens and closes this absorption throttle valve according to the rotational frequency signal of an inverter.
[0003]
[Problem(s) to be Solved by the Invention] In the above-mentioned Prior art, since the absorption throttle valve was blockaded and the displacement control of [at the time of a low load] was carried out, it was not fully taken into consideration about the following point. Although the close by-pass bulb completely of the intake throttle valve is carried out where the rotational frequency of a compressor is reduced at the time of a low load, reduction of :1. power is inadequate.
2. With a specification pressure, since suction pressure declines, as compared with the time of a full load, the amount of oil supply increases the discharge pressure of a compressor. If the amount of oil supply increases at the time of low-speed rotation, increase of operation power and need driving torque will be caused, and there is a possibility that the trip of an inverter etc. may arise, in the inverter driver to which driving torque falls in a low-speed rotation region.
3. Since the workload of a compressor is mitigated after the discharge pressure of a compressor has gone up from a specification pressure or it, the capacity of an upper oil cooler goes up relatively, and the oil supply temperature to a compressor falls. In connection with this, the discharge temperature of a compressor falls and the possibility of generating of the drain within an oil separator becomes high.
[0004] By the way, in order to improve the power at the time of a low load, the approach of repeating two conditions (a) in the condition of making (a) intake throttle valve into a close by-pass bulb completely, and opening the pressure in an oil separator, and the condition of making (b) intake throttle valve full open, and (b) is also proposed. However, in this approach, the pressure margin for shifting to the condition of (a) and (b) is required, therefore produces a possibility of falling from a setting pressure. And since the frequency of an intake throttle valve or a solenoid valve of operation increases even when control pressure is secured, there is a possibility of reducing the endurance of these valves.

[0005] The purpose of this invention is to reduce generating of the drain within an oil separator while reducing the power of a compressor, carrying out improvement in maintenance of the dependability of a compressor.
[0006]
[Means for Solving the Problem] The 1st description of this invention for attaining the above-mentioned purpose In the operating method of the screw compressor in which gear change operation driven with the motor using an inverter is possible While setting the rotational frequency of a compressor as the minimum rotational frequency which the rotational frequency of a compressor is changed and is used by revolving-speed-control operation corresponding to change of a load, and this revolving-speed-control operation It has no-load running which closes the intake throttle valve prepared in the screw compressor's intake side, and decompresses the discharge pressure of a screw compressor, and load operation and no-load running which were set as the minimum rotational frequency of revolving-speed-control operation are repeated from the predetermined load defined beforehand at the time of a low load.
[0007] And when no-load running continues beyond predetermined time at least in this description, And when it becomes one when the time amount ratio of no-load running and load operation in operation at the time of a low load exceeds a predetermined rate of operations Loads decrease in number, and the rotational frequency of a compressor turns into a minimum rotational frequency, absorb, and a throttle valve is blockaded.; which suspends a screw compressor -- furthermore, in case it is alike and changes to the operation mode which decompresses the discharge pressure of a compressor and repeats no-load running and load operation from revolving-speed-control operation When the pressure of; compressor which sets the upper-limit-of-pressure force P1 of control as P1>P0 to the setting pressure P0 of revolving-speed-control operation declines and a compressor reboots, even if loads decrease in number, operation of a predetermined time (t1) compressor is continued, and, as for after predetermined time (t1) progress, it is desirable to stop a compressor.
[0008] The 2nd description of this invention for attaining the above-mentioned purpose In the screw compressor which prepared the absorption throttle valve which has Rota of the male-and-female pair supported by bearing pivotable, is equipped with the motor which drives this Rota, and the inverter which controls this motor, and adjusts a flow rate to a suction side A revolving-speed-control means to change the engine speed of a motor with an inverter and to control the capacity of a screw compressor, It absorbs, while driving a screw compressor with the minimum engine speed set as this revolving-speed-control means, and a throttle valve is blockaded, and it has the capacity control means to which no-load running which decompresses the discharge pressure of a screw compressor is made to carry out.
[0009] And when the setting pressure of P2 and revolving-speed-control operation is set to P0, the lower limit of the discharge pressure when changing to load operation which is operation which opens P1 for the upper limit of the discharge pressure when changing a compressor to no-load running in this description, and opens a compressor for the sink throttle valve in said minimum engine speed A; revolving-speed-control means by which said capacity control means sets P1 and P2 as P1>P0 and P2>=P0 ; revolving-speed-control means stopped since a pressure is raised to P3 set to P3>P0 to said setting pressure P0 in case a compressor stops automatically by reduction in a load When setting to P4 the pressure which reboots a compressor, while forming a discharge-pressure detection means to detect the discharge pressure of; compressor controlled to be set to P4>=P0 in the discharge side of a compressor The setting pressure (P0) in revolving speed control, and upper-limit-of-pressure force (P1) and lower-limit pressure force (P2) of a displacement control, A storage means to memorize the pressure (P3) made to stop automatically and the reboot pressure after automatic stay (P4), The change means which changes actuation of a revolving-speed-control means and a capacity control means based on the detection pressure force detected by the discharge-pressure detection means, The setting pressure in; revolving speed control which established the input means whose modification of the value of P0, P1, P2, P3, and P4 which were memorized by the storage means is enabled (P0), The upper-limit-of-pressure force (P1) of a displacement control, the lower-limit pressure force (P2), and the pressure made to stop automatically (P3), A discharge-pressure detection means to detect; discharge pressure equipped with a storage means to memorize the reboot pressure after automatic stay (P4), and the setting pressure means which carries out an operation setup of each setting pressure (P1, P2, P3, P4) based on a setting pressure (P0) is established. While a revolving-speed-control means carries out revolving speed control based on the discharge pressure which this discharge-pressure detection means detected, it is more desirable than the load beforehand defined based on the discharge pressure which this discharge-pressure detection means detected to operate a capacity control means by the low load.

[0010] Thus, in constituted t[redacted]vention, a motor is controlled in 100 to 3[redacted] of range of the rated regurgitation air content of a compressor using an inverter, and the rotational frequency of a compressor is changed and carries out a displacement control, for example. When the amount of the air used falls to 30% or less, while the rotational frequency of a compressor is fixed to the rotational frequency at the time of 30% load (minimum rotational frequency) and an absorption throttle valve is blockaded, the discharge pressure of a compressor is decompressed. Since the pressure of the discharge side of a compressor declines at the same time the inflow of the air to a compressor is intercepted, consumption power is reduced remarkably. In 30% or less of load field, it is carrying out by repeating this no-load running and load operation at a minimum rotational frequency, and capacity is adjusted.
[0011] Moreover, when no-load running continues for 10 minutes, for example, a compressor is stopped automatically. Or, for example in 10% or less of load field, it sets up so that a compressor may be stopped automatically.
[0012] Moreover, when loads decrease in number, for example, the amount of the air used falls to 30% or less, the rotational frequency of a compressor is held to the set point (minimum rotational frequency), and also when the amount of the air used decreases further, operation with a lower cut off frequency is continued. And an absorption throttle valve is blockaded and the discharge pressure of a compressor is decompressed. If the discharge pressure of a compressor reaches the pressure P1 used as P1>P0 when it goes into the capacity regulatory region of this no-load running and the setting pressure in a revolving-speed-control field is set to P0, while blockading an absorption throttle valve, he decompresses the discharge pressure of a compressor and is trying to go into no-load running. Moreover, also when an automatic-stay function is in a compressor, the above-mentioned approach is enforced.
[0013] Furthermore, the pressure P2 (lower-limit pressure force) returned to load operation from no-load running is made into the pressure beyond [above-mentioned] setting-pressure P0. And in the case of 100 to 30% of the rated regurgitation air content of a compressor, an air consumption controls a rotational frequency, and it operates so that it may become a constant pressure in the setting-pressure P0 neighborhood. On the other hand, when an air consumption is 30% or less, according to an air consumption, no-load running and load operation at a minimum rotational frequency are repeated between the pressures of P1 and P2 used as P1>P2>=P0.
[0014] An air consumption decreases further, and when the conditions which a compressor stops automatically are ready, the period of load operation in a minimum rotational frequency is established, and a compressor is stopped after a pressure rises to P3 set to P3>P0 to the setting pressure P0 mentioned above. A compressor will be rebooted if it falls to P4 from which consumption of air begins from and a pressure is set to P4>=P0.
[0015] In addition, while detecting the pressure of said P1, P2 and P3, and P4 grade using a pressure sensor, each setting pressure may be stored in storage. each -- it calculates with an arithmetic unit automatically and setting-pressure P1-P4 may be set up, when a pressure P0 is set up. Moreover, you may have an input means to change the set point manually. Thereby, while being able to set up each setting pressure proper, modification of the set point becomes easy.
[0016]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained using a drawing about some examples. The mimetic diagram of the screw-compressor equipment applied to the example of this invention at drawing 1 is shown. After the air inhaled from the suction strainer 1 passes through the absorption throttle valve 2, it is compressed between Rota 3 of a screw compressor, and it is breathed out from a delivery 4. In order to cool the heat of compression generated by compression, a lubricating oil is poured into the Rota 3 section of a screw compressor 12 for lubrication and a seal. It flows in the oil separator tank 5, and dissociates with a lubricating oil with the oil separator element 6, and the compressed air breathed out with the lubricating oil from the delivery 4 is breathed out to the external device which does not illustrate a check valve 8 and a pressure regulating valve 9 one by one from the regurgitation piping 7 after a connoisseur flows into an after cooler 10 and being cooled in this after-cooler 10.
[0017] On the other hand, it dissociates with the compressed air within the oil separator tank 5, and a lubricating oil is led to an oil cooler 11 from the pars basilaris ossis occipitalis of the oil separator tank 5. It is mixed within a thermostatic valve 13 and the lubricating oil cooled by the oil cooler 11 and the lubricating oil which is not cooled [which does not go via an oil cooler] carry out the lubrication of the screw compressor 12. A cooling fan 14 is the style of cooling and an oil cooler 11 and an after-cooler 10 are cooled.
[0018] As for Rota 3 shaft of a screw compressor, and motor 16 shaft, rotation is connected with a belt 15.

As for the motor 16, adjustable speed operation is attained with the inverter 17. The pressure sensor 18 was formed in the downstream of a check valve 8, and the pressure breathed out from a screw compressor 12 is detected. The output signal of this pressure sensor 18 is inputted into the I/O section 19. Control unit section 20a has the storage means and the PID function. And the memorized setting pressure and the pressure which the pressure sensor 18 detected are measured, a frequency from which the detection pressure force turns into the target preassure force P0 is given to an inverter 17, and the rotational frequency of a motor 16 is changed. Various kinds of pressure set points memorized by this storage means and control unit section 20a are automatically set as a proper value only by setting up the target preassure force P0. Moreover, it has composition which can change the set point using setting input means and display 20b connected to control unit section 20a. Furthermore, display means (LED, liquid crystal device, etc.) are put side by side to setting input means and display 20b, and the set point and the operation frequency of a pressure are displayed.

[0019] Ports-plate 2a of the intake throttle valve 2 prepared in the upstream of a screw compressor 12 will operate in the closed direction, if piston 2b receives a pressure from a solenoid-valve 21 side. That is, if a solenoid valve 21 serves as open, the high-pressure force in an oil separator 5 will be led to the intake throttle valve 2, and a pressure will be added to this piston 2b. Furthermore, while a solenoid valve 21 serves as open, air discharge of a part of air in an oil separator 5 is carried out via an air-discharge piping 22 to an intake throttle valve's 2 intake side. At this time, a flow rate is adjusted by the orifice 23. Instead of piping 22, you may make it the configuration which carries out air discharge to direct atmospheric air. In addition, a solenoid valve 21 is opened and closed based on the result of having compared the setting pressure set up with automatic or hand control in storage means and control unit section 20a with the pressure signal from the I/O section 19 inputted into this storage means and control unit section 20a.

[0020] Thus, an operation of the constituted screw-compressor equipment is described below. If an oil-injection-type screw compressor is driven with the motor using an inverter, it will become possible to reduce the rotational frequency of a compressor 12 with reduction of a use air content, and the big power reduction effectiveness will be acquired compared with other capacity control systems. Although this is known well conventionally, the following demerits will be invited if revolving speed control is performed in all the fields of a regurgitation air content.

[0021] Namely, if it is required to use together the displacement control which used the absorption throttle valve etc. and it becomes (1) low rotational frequency further in a low rotational frequency or a small air content region The rotational frequency of a motor 16 and cooling-fan 16a prepared in one also falls to coincidence. In order to perform oil supply to the (2) compressor 12 with which a motor cannot be cooled but motor coil temperature crosses a predetermined temperature requirement using the differential pressure inside an oil separator 5 and a screw compressor 12, The fault that it becomes a low rotational frequency, and it does not decrease, but liquid compression of an oil occurs in the screw compression inside-of-a-plane section, and the amount of oil supply will be in an overload condition even if the exit condition of a screw compressor decreases sharply is produced.

[0022] It becomes [structure] complicated and is not realistic, although various approaches, such as preparing the valve for adjusting the amount of oil supply in a low rotational frequency region which prepares the fan who drove by the exclusive motor, can be considered in order to avoid such faults, and to cool a motor.

[0023] Then, in the thing given in JP,7-35079,A, the displacement control by revolving speed control was not performed, but it absorbed, while becoming the set-up minimum rotational frequency, and the throttle valve 2 was closed, and it was considering as the no-load-running condition in the small air content region. However, although this method could expect the energy-saving effectiveness as compared with the conventional method, it was still inadequate. So, as shown in drawing 1 , a device is constituted and the capacity of a screw compressor is controlled by this invention. The detail flow is shown in drawing 4 .

[0024] To a specification regurgitation air content, by the operating range of about 30 to 100% of air content, the drive frequency of a motor 16 is changed with an inverter, and revolving speed control is carried out. On the other hand, if a regurgitation air content becomes 30% or less of operating range of a specification regurgitation air content, when the discharge pressure of the compressor detected with the pressure sensor 18 will have reached the setting pressure P1 memorized by a storage means and the control-output section, the rotational frequency of a screw compressor is held to the setting minimum rotational frequency in revolving speed control. And a solenoid valve 21 is opened and the absorption throttle valve 2 is blockaded. Moreover, the discharge pressure of a compressor 3 is decompressed and it switches to the displacement control of no-load running. Thereby, the pressure in the delivery 4 of a compressor 12 declines, and it becomes

possible to the conventional technique to reduce consumption power sharply.
[0025] The ratio of consumption power to the regurgitation air content ratio in this case is shown in drawing 2 . The consumption power property according [A line in drawing 2] to the conventional method and B line are the consumption power properties by one example of this invention. At about 0%, consumption power is decreasing [the regurgitation air content ratio] even to one half extent as compared with the former.
[0026] Since the discharge pressure was reduced, the amount of oil supply to the compressor rotor 3 section can also be decreased, and there is no possibility of causing unusual increase of the torque generated when liquid compression of the lubricating oil is carried out. Moreover, if a screw compressor is operated by the low load, oil supply temperature will fall and it will become easy to generate a drain in an oil separator 5, but since the pressure in an oil separator 5 also declines at the time of no-load running, the possibility of generating of a drain decreases.
[0027] Furthermore, the rotational frequency of a compressor is held to this setting minimum rotational frequency, and it judges with the timer means in which the time amount of no-load running to which the discharge pressure of a compressor 3 falls as a result of making the absorption throttle valve 2 into a state of obstruction and operating, and the time amount of load operation which holds the rotational frequency of a compressor to a setting minimum rotational frequency, opens the absorption throttle valve 2, and is operated were built by a storage means and the control-output section. A compressor is stopped when [of the former] the operation time of 10% or less of load or the former exceeds for 3 minutes continuously comparatively. Furthermore, a pressure is continuously supervised with a pressure sensor 18 also during a halt, and a compressor is rebooted when a pressure declines to the setting pressure P4 memorized by a storage means and the control unit section. Thus, if operation of a compressor is controlled, C line would come to have shown a consumption power property in drawing 2 , and reduction of the power in a operating range with little pan air consumption will be attained.
[0028] In addition, when a consumption air content decreases and the rotational frequency of a compressor turns into a setting minimum rotational frequency in the above-mentioned example, The target setting pressure P0 and no-load running (while a rotational frequency is fixed, and is absorbed and a throttle valve 2 is blockaded henceforth, the operational status which decompresses the discharge pressure of a compressor 3 is called no-load running.) in a revolving-speed-control field The upper-limit-of-pressure force P1 to start is the same, when an air consumption is in agreement with the switching point of a control system, an unstable ON-OFF command occurs in a solenoid valve 21, and hunting of the absorption throttle valve 2 may be caused.
[0029] In a common fixed ** type motor drive screw compressor, in not performing the displacement control which blockades only an absorption throttle valve, it has set specification pressure P0* of a compressor, and setting upper-limit-of-pressure force P1* included in no-load running as the same pressure. It is because it designs so that a motor may serve as the permission maximum output at the time of the full load operational status in a specification pressure. That is, when a motor will be in an overload condition if setting upper-limit-of-pressure force P1* of initiation of no-load running is made higher than specification pressure P0*, and setting upper-limit-of-pressure force P1* of initiation of another side and no-load running is made lower than specification pressure P0*, before reaching a specification pressure, it is for the fault of going into no-load running to arise.
[0030] On the other hand, since no-load running is started at the minimum rotational frequency of the revolving-speed-control field by the inverter in this invention, even if there is no limit of the compressor of a 1 fixed-speed motor drive and it sets up highly the initiation pressure P1 of no-load running to the target setting pressure P0 (namely, specification pressure in the case of the compressor of a 1 fixed-speed motor drive) in a revolving-speed-control field, problems, such as an overload of a motor, are not generated at all. Then, in this invention, P1 is set up so that it may be set to P1>P0. For example, P1 is set to 0.79Mpa(s) when P0 is 0.69Mpa(s). Thus, by setting up, a time lag can be given between a revolving-speed-control field and 1 constant speed control in a minimum rotational frequency, and there is no possibility that hunting mentioned above may occur.
[0031] In addition, it separates from the control condition which suits a compressor depending on a setting pressure, and there is a possibility of producing un-arranging. Then, if the target setting pressure P0 is inputted, a proper value will be calculated automatically, and the approach of determining P1-P4 is used. An example of this decision approach of P1-P4 is shown below. Now, suppose that the pressure P0 was P0=0.69MPa. When becoming a low load in this condition, the 0.098MPa rise of the maximum pressure is carried out, and an operation called P1=P0+0.098=0.79MPa is made to perform. Here, since the blowdown

pressures of a relief valve are [redacted]3MPa(s), the control upper-limit-of-pressure force has satisfied the conditions below of this blowdown pressure. Next, the conditions of the pressure P2 which can be stopped are P2>=P1. that is, -- if P1=P2 carry out load operation and it is set to P1=P2, since it will change to unload operation -- this unload operation -- calculate time amount until it changes and a pressure descends from the time to P0, with [this time amount] predetermined time [beyond], it is made to stop, and with predetermined time [less than], a control unit is operated so that it may become load operation. The pressure P3 returned to load operation is P3=<P0. Moreover, the pressure P4 for making it reboot after shutdown is set to P4=P0-0.098MPa=0.59MPa.

[0032] Thus, if it becomes more than P0=0.83MPa when each pressures P0-P4 are set up, it will be set to P1=(P0+0.098) >0.93MPa, and the blowdown pressure of a relief valve will be exceeded. Then, the storage means which the control unit of a compressor has is made to memorize the experimental formula which suited each specification which is expressed with P1=P0+(0.07/P0) MPa. That is, in accordance with the setting pressure of each compressor, each setting pressure can be automatically determined only in the input of P0 by making operation expression memorize the formula according to a specification. In addition, a discrete value may be interpolated and used although the relation between each setting pressure was given by operation expression in this example. Moreover, although the storage means is made to memorize this relational expression, the thing which an enternal memory means like a floppy (trademark) disk was made to memorize may be used.

[0033] By the way, when a 1 fixed-speed motor was used conventionally, generating of the differential pressure resulting from the switching action of an absorption throttle valve or a solenoid valve was not avoided. For example, even if indispensable pressures were 0.59Mpa(s), load operation and no-load running were repeated between 0.69Mpa and 0.59Mpa(s). On the other hand, it is not necessary to become possible to fix a pressure by PID control and to change a rotational frequency, and to carry out a pressure up to a high pressure vainly by making indispensable pressure 0.59Mpa into the target setting pressure P0 in a revolving-speed-control field, and the power-saving effectiveness is acquired by the revolving-speed-control method using an inverter. However, this effectiveness will also be reduced by half, if a pressure is controlled between 0.59Mpa(s) and 0.49Mpa(s) and a pressure declines at 0.59 or less Mpas during no-load running in the low load field which does not control a rotational frequency. That is, when a pressure falls to 0.59 or less Mpas and it is inconvenient, P0 cannot be reduced after all.

[0034] Then, a pressure sensor 18 detects that the compressed air is consumed and a discharge pressure declines after going into no-load running. Moreover, are the same as the target setting pressure P0 in a revolving-speed-control field, or let the pressure (lower-limit pressure force) P2 when returning to load operation be a pressure beyond it. Also when an air consumption decreases further from a revolving-speed-control field by this, operation becomes possible by the pressure always higher than the target setting pressure in a revolving-speed-control field. Moreover, even if it raises control pressure, since it is a low load field, the increment in operation power is very small, and ends.

[0035] Next, the modification of this invention is shown. This modification is about control when loads decrease in number. When loads decrease in number, automatic stay and an automatic restart are performed by the above-mentioned timer function. At this time, if the automatic-stay conditions of a compressor are ready, load operation will once be performed compulsorily, a pressure is raised to P3 once set to P3>P0 to the target setting pressure P0 in a revolving-speed-control field in the discharge pressure of a compressor, and, subsequently a compressor is stopped. Moreover, the pressure P4 which reboots a compressor is set as P4>=P0 to the target setting pressure P0 in a revolving-speed-control field. Thereby, also in the low load field held to a fixed rotational frequency, a compressor is controllable to stability. That is, according to this modification, since the target setting pressure in a revolving-speed-control field is maintainable in all load fields, the power-saving effectiveness of the revolving speed control by the above-mentioned inverter that a compressor can be operated by the indispensable pressure can be demonstrated to the maximum extent.

[0036] In addition, in the above-mentioned example, the set point of control pressure is stored in storage means 20a, and using a display and input means 20b, when required, it can be displayed. Moreover, if control pressure P0 is inputted, although it calculates automatically and is determined, even if these set points use a display and input means 20b, they can be performed easily. For example, in the example which restricts a maximum pressure with a pressure, the above-mentioned control pressure P0, P1, P2, P3, and P4 of five pieces is set up using the formula of P1=P3=P0+(0.07/P0) MpaP2=P4=P0, it stores in a storage means beforehand, and only P0 is usually changed. In this case, an operating pressure can be changed easily.

[0037] In addition, it cannot be overemphasized that each setting pressure can be decided manually. For

example, the value of X and [redacted] inputted as P1=P2=P3=P0+X and P4=P0-[redacted]sing the input switch which is displayed on an indicating equipment and which was formed on the control panel side while sometimes looking at the value of ****. Here, it is 0.001>X or Y> 0.098.

[0038] Moreover, a compressor is made to stop automatically, when the compressor between predetermined time t1 is not stopped and the load conditions of a compressor have, in addition, satisfied said automatic-stay conditions also even for after this time amount t1 progress, even if it forms the timer which starts a count after an automatic restart in storage means and control unit section 20a and loads decrease in number. Before the oil temperature which originates in a compressor repeating operation and a halt frequently by this fully rises, it can prevent that a compressor stops and a drain is generated in an oil separator 5.

[0039] The air consumption when using the method of controlling the screw compressor mentioned above and the example of change of a pressure are shown in drawing 3 , and an example of the flow of the operation control of a screw compressor is shown in drawing 4 .

[0040] In this invention, in the revolving speed control which used the inverter, the screw compressor which combines a displacement control, and its operating method, it absorbs during displacement-control operation, and the operating range of the conventional approach which blockades and carries out the displacement control only of the throttle valve completely twists, and, thereby, can reduce reduction of power, and generating of a drain.

[0041] As stated above, according to this example, in the displacement control at the time of a low load, setting pressure becomes easy in inputting a control setting pressure, and there is no un-arranging [of the machine by the flow and pressure requirement]. Moreover, since it has the function in which an input value can be changed and checked, the operational status of a compressor can always be grasped and the dependability in compressor operation can be improved.

[0042]

[Effect of the Invention] When according to this invention the load of a screw compressor reduces the rotational frequency of a compressor and operates by the low load, the reduction effectiveness of (1) power serves as size.

(2) Need driving torque does not increase and the trip of an inverter does not arise in an inverter drive compressor.

(3) Since the discharge pressure of a compressor also declines, there is no possibility that a drain may be generated within an oil separator.

(4) Since a pressure required for revolving speed control is securable even if a load falls further and it stops a compressor, the setting pressure of revolving speed control can be reduced and power can be mitigated to near the ideal.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the mimetic diagram of the screw-compressor equipment concerning one example of this invention.

[Drawing 2] It is the graph which shows the property of consumption power.

[Drawing 3] It is the graph which shows an example of change of an air consumption and a pressure.

[Drawing 4] It is the flow chart of an example of an operation control.

[Description of Notations]

2 [.. A check valve, 9 / .. A pressure regulating valve, 16 / .. A motor, 17 / .. An inverter, 18 / .. A pressure

sensor, 19 / .. The I/O section, 20a / .. A storage means and the control unit section, 20b / .. A display and the setting input means section, 21 / .. Solenoid valve.] .... An intake throttle valve, 5 .. An oil separator, 6 .. An oil separator element, 8

[Translation done.]